Attorney Docket No. 1015290-000682

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

OIPE IAP89 AUG 26 2008 PATENT & TRADEMARK OFFICE

In re Patent Application of Robert J. Steger Application No.: 10/608,091 Filed: June 30, 2003 For: SUBSTRATE SUPPORT HAVING DYNAMIC TEMPERATURE CONTROL	**Mail Stop APPEAL BRIEF - PATENTS** Group Art Unit: 1763 Examiner: RAKESH KUMAR DHINGRA Confirmation No.: 8130 Appeal No.:

SECOND APPEAL BRIEF

Mail Stop APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
Sir:

This appeal is from the Official Action mailed January 25, 2008, finally rejecting Claims 1-12 and 15-23, which are reproduced as the Claims Appendix of this brief.

☐ A check covering the ☐ $ 250 ☐ $ 510 Government fee is filed herewith.

☒ Charge ☐ $ 250 ☒ $ 510 to Deposit Account No. 02-4800.

The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§1.16, 1.17, and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800.

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I. Real Party in Interest

The present application is assigned to Lam Research Corporation.

II. Related Appeals and Interferences

The Appellant's legal representative, or assignee, does not know of any other appeals or interferences which will affect or be directly affected by or have bearing on the Board's decision in the pending appeal.

III. Status of Claims

Claims 1-3, 5-29, 32 and 33 are being appealed. Claims 4 and 30 have been cancelled; and Claims 13, 14, 24-29 and 31 have been withdrawn from consideration. See attached Claims Appendix for a copy of the claims involved in the appeal.

IV. Status of Amendments

Independent Claim 1 was amended to incorporate a feature of Claim 32; and independent Claim 15 was amended to incorporate a feature of Claim 33 in an after final Amendment filed April 25, 2008. For the purposes of appeal, these claim amendments were entered as indicated in an Advisory Action mailed May 12, 2008.

V. Summary of Claimed Subject Matter

The claimed substrate support provides for a heat transfer member with a low thermal mass and dynamic temperature control capabilities for rapid heating and/or cooling to a desired temperature (page 5, lines 7-10; paragraph **[0019]**). Such a

substrate support provides additional capabilities during the plasma processing of semiconductor substrates, for example, accurate, step-changeable temperature control in gate and shallow trench isolation etching processes (page 14, lines 10-19; paragraph **[0049]**). Further examples of increased capabilities include the ability to linearly ramp temperature to form tapered sidewalls or more effectively prevent thermal damage to the substrate during dielectric etch (page 14, lines 10-19; paragraph **[0049]**). The low thermal mass of the claimed substrate support also provides the advantage of consuming a smaller volumetric flow rate of liquid to achieve the desired temperature, as compared to a larger cold plate having a large thermal mass (page 12, lines 12-16; paragraph **[0043]**).

Claims 1-11 are directed towards a substrate support useful in a reaction chamber of a plasma processing apparatus. Claim 12 is directed at a plasma processing apparatus comprising the substrate support of Claim 1. Claims 15-22 are directed towards a substrate support useful in a plasma processing apparatus. Claim 23 is directed at a plasma processing apparatus comprising the substrate support of Claim 15. Claims 1 and 15 are independent claims.

Claim 1 is directed at a substrate support useful in a reaction chamber of a plasma processing apparatus. The substrate support comprises a ceramic member and a metallic heat transfer member overlying the ceramic member. The heat transfer member has a maximum thickness of about ¼ inch and includes at least one flow passage through which a liquid can be circulated to heat and cool the heat transfer member. An electrostatic chuck overlies the heat transfer member. The electrostatic chuck has a support surface for supporting a substrate in a reaction chamber of a plasma processing apparatus. A source of temperature controlled

liquid is in flow communication with the at least one flow passage. A controller is operable to control the volumetric flow rate and/or the temperature of the liquid circulated through the at least one flow passage, so as to control heating and cooling of the heat transfer member at a rate of from about 0.25-2°C/sec. Heating is performed solely by the heat transfer member

An example of the claimed reaction chamber 10 is described in the specification, at page 5, line 26 to page 6, line 14 (paragraphs **[0022]**-**[0023]**); and FIG. 1. An example of the claimed substrate support 12, 40 is described at page 6, lines 6-14 (paragraph **[0023]**); at page 6, line 26 to page 7, line 9 (paragraph **[0026]**); and FIGS. 1-2. An example of the claimed heat transfer member 48 is described at page 7, lines 10-18 (paragraph **[0027]**); and FIG. 2. Exemplary flow passages 76 are described at page 9, line 22 to page 10, line 10 (paragraphs **[0035]**-**[0036]**); at page 7, lines 10-18 (paragraph **[0027]**); and FIG. 5. An example of the claimed ceramic member 46 is described at page 6, line 26 to page 7, line 9 (paragraph **[0026]**); and FIGS. 1-2. An example of electrostatic chuck 34, 50 is described at page 6, lines 6-14 (paragraph **[0023]**); at page 6, line 26 to page 7, line 9 (paragraph **[0026]**) and FIGS. 1-2. Exemplary controller 200 is described at page 12, lines 17-27 (paragraph **[0044]**); at page 13, lines 12-20 (paragraph **[0046]**); and FIG. 2.

Claim 15 is directed at a substrate support useful in a plasma processing apparatus. The substrates support comprises a source of temperature controlled liquid; a ceramic member; and a metallic heat transfer member overlying the ceramic member. The heat transfer member includes at least one flow passage in fluid communication with the liquid source and through which the liquid can be circulated to heat and cool the heat transfer member at a rate of from about 0.25-2 °C/sec. An

electrostatic chuck overlies the heat transfer member. The electrostatic chuck has a support surface for supporting a substrate in a reaction chamber of a plasma processing apparatus. A controller is operable to control the volumetric flow rate and/or the temperature of the liquid circulated through the at least one flow passage. Heating is performed solely by the heat transfer member.

An example of the claimed reaction chamber 10 is described in the specification, at page 5, line 26 to page 6, line 14 (paragraphs **[0022]**-**[0023]**); and FIG. 1. An example of the claimed substrate support 12, 40 is described at page 6, lines 6-14 (paragraph **[0023]**); at page 6, line 26 to page 7, line 9 (paragraph **[0026]**); and FIGS. 1-2. Exemplary liquid source 100 is described at page 7, lines 10-18 (paragraph **[0027]**); at page 13, line 21 to page 14, line 24 (paragraph **[0047]**); and FIG. 2. An example of the claimed substrate support 12, 40 is described at page 6, lines 6-14, (paragraph **[0023]**); at page 6, line 26 to page 7, line 9 (paragraph **[0026]**); and FIGS. 1-2. An example of the claimed heat transfer member 48 is described at page 7, lines 10-18, (paragraph **[0027]**); and FIG. 2. An example of the claimed ceramic member 46 is described at page 6, line 26 to page 7, line 9 (paragraph **[0026]**); and FIGS. 1-2. Exemplary flow passages 76 are described at page 9, line 22 to page 10, line 10, (paragraphs **[0035]**-**[0036]**); at page 7, lines 10-18, (paragraph **[0027]**); and FIG. 5. An example of electrostatic chuck 34, 50 is described at page 6, lines 6-14, (paragraph **[0023]**); at page 6, line 26 to page 7, line 9 (paragraph **[0026]**) and FIGS. 1-2. Exemplary controller 200 is described at page 12, lines 17-27, (paragraph **[0044]**); at page 13, lines 12-20, (paragraph **[0046]**); and FIG. 2.

VI. Grounds of Rejection to be Reviewed on Appeal

A. Claims 1, 2, 10, 12, 15, 16, 21 and 23

Claims 1, 2, 10, 12, 15, 16, 21 and 23 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Yatsuda et al. (U.S. Patent No. 6,488,863) ("Yatsuda") in view of Chiang et al. (U.S. Patent No. 6,800,173) ("Chiang") and Ramanan (U.S. Patent No. 6,529,686) ("Ramanan").

B. Claims 8 and 19

Claims 8 and 19 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Yatsuda in view of Chiang and Ramanan and further in view of Mahawili et al. (U.S. Patent No. 6,007,635) ("Mahawili").

C. Claims 32 and 33

Claims 32 and 33 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Yatsuda in view of Chiang and Ramanan and further in view Gaylord et al. (U.S. Patent No. 5,849,076) ("Gaylord").

VII. Argument

A. Legal Standards

1. Obviousness

Under 35 U.S.C. §103(a), the Examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. M.P.E.P. § 2142. For a proper obviousness rejection, the Patent Office must provide "some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness" and not "mere conclusory statements." *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741 (2007) (quoting *In re Kahn*, 441 F.3d 977, 988, (Fed. Cir. 2006)).

2. Proper Articulated Reasoning to Support a Conclusion of Obviousness

To reject a claim based on combining prior art elements according to known methods to yield predictable results, M.P.E.P. § 2143 (A) states that the Office must articulate the following:

> (1) a finding that the prior art included each element claimed, although not necessarily in a single prior art reference, with the only difference between the claimed invention and the prior art being the lack of actual combination of the elements in a single prior art reference;
> (2) a finding that one of ordinary skill in the art could have combined the elements as claimed by known methods, and that in combination, <u>each element merely performs the same function as it does separately</u>;
> (3) <u>a finding that one of ordinary skill in the art would have recognized that the results of the combination were predictable</u>; and
> (4) whatever additional findings based on the *Graham* factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness (emphasis added).

M.P.E.P. § 2143 (A) further states that if any one of these findings cannot be made, than this rationale cannot be used to support a conclusion that the claim would have been obvious to one of ordinary skill in the art.

To reject a claim based on simple substitution of one known element for another to obtain predictable results, , M.P.E.P. § 2143 (B) states that the Office must articulate the following:

> (1) a finding that the prior art contained a device (method, product, etc.) which differed from the claimed device by the substitution of some components (step, element, etc.) with other components;
> (2) a finding that the substituted components and their functions were known in the art;
> (3) <u>a finding that one of ordinary skill in the art could have substituted one known element for another, and the results of the substitution would have been predictable</u>; and
> (4) whatever additional findings based on the *Graham* factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness (emphasis added).

M.P.E.P. § 2143 (B) further states that if any one of these findings cannot be made, then this rationale cannot be used to support a conclusion that the claim would have been obvious to one of ordinary skill in the art.

2. Optimization of Ranges

In general, "where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955); M.P.E.P. § 2144.05(II)(A). However, a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of the variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977); M.P.E.P. § 2144.05(II)(B).

B. Rejection Under 35 U.S.C. §103(a) Over Yatsuda, Chiang and Ramanan - Claims 1, 2, 10, 12, 15, 16, 21 and 23

The final Official Action has rejected Claims 1, 2, 10, 12, 15, 16, 21 and 23 under 35 U.S.C. §103(a) as allegedly unpatentable over Yatsuda, Chiang and Ramanan (final Official Action at page 4, ¶1). However, the rejection is improper because: (1) the combination of Yatsuda, Chiang and Ramanan does not disclose or suggest all claim features; (2) Ramanan provides no recognition that the thickness of the cooling member is a result-effective variable; and (3) no articulated reasoning has been provided for the combination of Yatsuda, Chiang and Ramanan.

Independent Claim 1 recites, *inter alia*, a substrate support useful in a reaction chamber of a plasma processing apparatus, the substrate support comprising, a metallic heat transfer member overlying the ceramic member, the heat transfer member having a maximum thickness of about ¼ inch, the heat transfer member

including at least one flow passage through which a liquid can be circulated to heat and cool the heat transfer member; a controller operable to control the volumetric flow rate and/or the temperature of the liquid circulated through the at least one flow passage, so as to control heating and cooling of the heat transfer member at a rate of from about 0.25-2°C/sec wherein heating is performed solely by the heat transfer member (emphasis added).

Claims 15 recites, *inter alia*, a substrate support useful in a plasma processing apparatus, comprising, a metallic heat transfer member overlying the ceramic member, the heat transfer member including at least one flow passage in fluid communication with the liquid source and through which the liquid can be circulated to heat and cool the heat transfer member at a rate of from about 0.25-2 °C/sec wherein heating is performed solely by the heat transfer member (emphasis added).

1. **The Examiner's Position**

The final Official Action cites Yatsuda for the disclosure of insulating member **20** (e.g., ceramic), electrostatic chuck **28** and aluminum worktable **18** containing cooling jacket passageway **34** (final Official Action at page 4, lines 4-12). The final Official Action acknowledges that Yatsuda does not disclose the claim features of: (1) "heat transfer member having a maximum thickness of about ¼ inch"; (2) "liquid ... circulated to heat and cool the heat transfer member"; and (3) "a controller operable to control the volumetric flow rate and/or the temperature of the liquid circulated through the at least one flow passage, so as to control heating and cooling of the heat transfer member at a rate of from about 0.25-2°C/sec" (final Official Action at page 4, lines 15-21).

The final Official Action cites Chiang for control system **300** to control the temperature of wafer **8** on electrostatic chuck **6** with resistive heater **72** and contends that Chiang discloses the claim feature of "liquid ... circulated to heat and cool the heat transfer member" (final Official Action at page 5, lines 3-12); and the claim feature of "heating is performed solely by the heat transfer member" (Advisory Action at page 2, ¶2).

The final Official Action further cites Ramanan for the disclosure of bakeplate **20** having a thickness of 0.06 to 0.25 inch and contends that: (1) it would have been obvious to select a thickness of the claimed "heat transfer member" based on Ramanan's disclosure of bakeplate **20** (final Official Action at page 5, lines 16-25); and (2) the thickness of the claimed "heat transfer member" is a results-effective variable (final Official Action at pages 5-6, bridging paragraph). The final Official Action also cites Ramanan for the disclosure of a control system with cooling rates of 1°C/second to 50°C/second and concludes that the claim feature of "control heating and cooling of the heat transfer member at a rate of from about 0.25-2°C/sec" is obvious (final Official Action at pages 5-6, bridging paragraph).

2. The Combination of Yatsuda, Chiang and Ramanan Does Not Disclose All Claim Features

As explained below, even if the Yatsuda, Chiang and Ramanan were combined in manner suggested in the final Official Action, the claim features of "metallic heat transfer member having a maximum thickness of about ¼ inch including at least one flow passage" and "heating is performed solely by the heat transfer member" are still missing.

a. **Missing Claim Feature of a Metallic Heat Transfer Member Having a Maximum Thickness of About ¼ Inch Including at Least One Flow Passage**

Ramanan discloses a bakeplate **20**, which holds semiconductor device **12**, and includes "one or more heating elements ... preferably in the form of resistive heating element[s]" (emphasis added) (column 13, lines 43-45). In alternative embodiments, Ramanan discloses that bakeplate **70** is a laminate composed of dielectric layers (e.g., polyimide), thermally conductive layers (e.g., silicon carbide) and heating elements (column 18, lines 20-45).

To cool bakeplate **20**, it is placed in thermal contact with metallic cooling member **26** which serves as a "thermally massive heat sink" (column 13, lines 59-65) with "a liquid cooling medium" (column 14, lines 18-21) flowing through cooling channels **28** (column 13, line 66 to column 14, line 6; FIG. 1A). Ramanan further discloses that the ratio of the thermal capacity of metallic cooling member **26** to the bakeplate **20** is preferably is at least 10:1 and as high as 100:1 (column 13, lines 24-27). Thus, Ramanan provides no disclosure or suggestion of a "metallic heat transfer member having a maximum thickness of about ¼ inch including at least one flow passage," as recited in Claim 1.

Likewise, Chiang discloses process chamber **12** for atomic layer deposition, including electrostatic chuck **6** (supporting wafer **8** and above pedestal **4** in FIG. 28) (column 19, lines 34-50). Chiang discloses that electrostatic chuck **6** is cooled by cooling plate **110** attached to baseplate **112** with a plurality of cooling channels **78** (column 21, lines 6-14). However, from FIG. 27A, cooling plate **110** and baseplate **112** are thermally massive structures, rather than a "metallic heat transfer member

having a maximum thickness of about ¼ inch including at least one flow passage," as recited in Claim 1.

b. Missing Claim Feature of Heating Performed Solely by the Heat Transfer Member

The Examiner contends that Chiang's disclosure of "[t]emperature control can be accomplished by various techniques, including regulating the backside gas pressure, heating ESC **6** directly with resistive heater **72**, or regulating the temperature and/or flow of fluid in coolant channels **78**" (emphasis added) provides a disclosure of the claim feature "heating is performed solely by the heat transfer member" (Advisory Action at page 2, ¶2).

Chiang discloses that the temperature of a substrate can be modulated by heating or cooling electrostatic chuck (ESC) **6** (column 9, lines 48-49). To heat ESC **6**, power is supplied to resistive heater **72**; and to cool ESC **6**, "fluid from a coolant supply **76** ... flows in a plurality of coolant channels **78**" (emphasis added) (column 9, lines 53-56). Chiang provides no disclosure that heated fluid flows into coolant channels **78**.

As such, when the reference is considered in its entirety, Chiang's disclosure of "regulating the temperature and/or flow of fluid in coolant channels **78**" has been misinterpreted by the Examiner and provides no suggestion that "heating is performed solely by the heat transfer member," as recited in Claims 1 and 15.

3. Ramanan Provides No Recognition that the Thickness of the Cooling Member is a Result-Effective Variable

The final Official Action contends that the thickness of the bakeplate **20** of Ramanan is a result-effective variable which can be optimized to obtain a desired thermal mass (final Official Action at page 6, lines 1-3) and concludes that it would

have been obvious to optimize the thickness of the claimed "heat transfer member" (final Official Action at page 5, lines 16-18).

However, Ramanan discloses that bakeplate **20** is a heating element (column 13, lines 43-52) and that the thickness of bakeplate **20** can be between 0.06 and 0.25 inch to achieve a desired thermal mass (column 8, lines 53-66). In an alternative embodiment, Ramanan discloses that bakeplate **70** is a laminate formed of dielectric layers (e.g., polyimide), thermally conductive layers (e.g., silicon carbide) and heating elements (column 18, lines 20-45).

Ramanan also discloses a separate metallic cooling member **26** with cooling channels **28** (column 13, lines 59-67), in which the metallic cooling member **26** is characterized as having a "high thermal mass," such that the ratio of the thermal capacity of cooling member **26** to the bakeplate **20** is preferably is at least 10:1 and as high as 100:1 (column 13, lines 24-27). Ramanan does not disclose that the thickness of cooling member **26** with cooling channels **28** can be varied between 0.06 and 0.25 inch. As such, Ramanan does not recognize the thickness of metallic cooling member **26** to be a result-effective variable and thus, the thickness of the claimed "metallic heat transfer member" cannot be considered a result-effective variable. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977); M.P.E.P. § 2144.05(II)(B).

3. No Articulated Reasoning for the Combination of Yatsuda, Chiang and Ramanan

a. Thickness of Claimed Heat Transfer Member

The final Official Action cites Ramanan for the disclosure of bakeplate **20** having a thickness of 0.06 to 0.25 inch and contends that it would have been obvious

to select a thickness of the claimed "heat transfer member" based on Ramanan's disclosure of bakeplate **20** (final Official Action at page 5, lines 16-25).

However, to the extent the final Official Action is relying on simple substitution of one known element combining prior art elements according to known methods to yield predictable results, M.P.E.P. § 2143 (B) states that the Examiner must articulate a finding that one of ordinary skill in the art could have substituted one known element for another, and the results of the substitution would have been predictable. The final Official Action articulates no such finding.

i. Bakeplate of Ramanan is Heated by Resistive Heating and Cooled by a Thermally Massive Heat Sink

Ramanan discloses a bakeplate **20** having a thickness of 0.06 to 0.25 inch (column 8, lines 63-67), which holds semiconductor device **12**, and includes "one or more heating elements ... preferably in the form of resistive heating element[s]" (emphasis added) (column 13, lines 43-45). From Ramanan, the heating or chilling rates are achieved by resistively heating bakeplate **20** (column 13, lines 43-52) or contacting it with "thermally massive heat sink" cooling member **26** (column 13, lines 59-66).

ii. Worktable of Yatsuda is a Cooling Plate

Yatsuda discloses a thermally massive aluminum worktable **18** for a plasma etching apparatus **14** (column 3, lines 17-28; FIG. 1), in which worktable **18** supports semiconductor wafer W (column 3, lines 34-39). Cooling jacket passage **34** in worktable **18** maintains wafer W "at a predetermined temperature by causing a coolant to flow in the jacket **34**" (column 3, lines 53-55). Yatsuda discloses that the temperature of worktable **18** is set from -30°C to 30°C during processing (column 6, lines 19-21; lines 42-43).

iii. **Predictable Results Lacking**

The final Official Action has made no finding that modifying aluminum worktable **18** of Yatsuda such that worktable **18** has a thickness 0.06 to 0.25 inch, as disclosed by Ramanan, would result in a predictable heating and cooling rates. Furthermore, the heating and cooling rates of Ramanan are achieved by a combination of a resistively heating bakeplate **20** (column 13, lines 43-52) and cooling bakeplate **20** by contacting it with "thermally massive heat sink" cooling member **26** (column 13, lines 59-66). However, the objective of worktable **18** of Yatsuda is to maintain wafer W at a predetermined temperature (column 3, lines 53-55), rather than altering the temperature of wafer W. As such, merely modifying the thickness of worktable **18** of Yatsuda would have an unknown and unpredictable effect on heating and cooling rates.

b. **Claimed Controller**

The final Official Action cites Ramanan for the disclosure of a control system with cooling rates of 1°C/second to 50°C/second and concludes that the claim feature of "control heating and cooling of the heat transfer member at a rate of from about 0.25-2°C/sec" is obvious (final Official Action at pages 5-6, bridging paragraph).

However, to the extent the final Official Action is relying on combining prior art elements according to known methods to yield predictable results, M.P.E.P. § 2143 (A) states that the Examiner must articulate: (1) a finding that one of ordinary skill in the art could have combined the elements by known methods, and that in combination, each element merely performs the same function as it does separately; and (2) a finding that one of ordinary skill in the art would have recognized that the

results of the combination were predictable. The final Official Action articulates no such finding.

i. No Finding That Each Element Merely Performs the Same Function As It Does Separately

Ramanan discloses a control system for heating or chilling rates between 1°C/second to 50°C/second (column 4, lines 50-54). However, to achieve this rapid heating or chilling, it is necessary for the control system to be used in conjunction with "low thermal mass" bakeplate **20** of Ramanan with heating elements (column 13, lines 43-48; column 4, lines 55-59) coupled with "thermally massive" cooling member **26** (column 13, lines 59-65; column 5, lines 30-42). The heating or chilling rates of 1°C/second to 50°C/second are achieved by resistively heating bakeplate **20** (column 13, lines 43-52) or contacting it with "thermally massive heat sink" cooling member **26** (column 13, lines 59-66). The final Official Action has made no finding that the control system of Ramanan can function independently of low thermal mass bakeplate **20** and massive heat sink cooling member **26** to achieve heating or chilling rates of 1°C/second to 50°C/second.

ii. No Finding That One of Ordinary Skill in the Art Would Have Recognized that the Results of the Combination Were Predictable

Chiang discloses that power is supplied to resistive heater **72** to heat ESC **6** and cooling fluid flows in coolant channels **78** to cool ESC **6** (column 9, lines 53-56). From FIGS. 27A and 28, ESC **6** and cooling plate **110** are both thermally massive structures. Yatsuda discloses worktable **18** containing cooling jacket passageway **34** (column 3, lines 53-55). Likewise, Yatsuda discloses a thermally massive

worktable **18** (FIG. 1) and provides no disclosure of heating worktable **18** with a heating element.

The final Official Action has made no finding that configuring the control system **330** of Chiang or worktable **18** of Yatsuda with the control system of Ramanan would predictably result in heating or chilling rates between 1°C/second to 50°C/second. Such heating or chilling rates of 1°C/second to 50°C/second in Ramanan are achieved by a "low thermal mass" resistively heated bakeplate **20** or contacting it with "thermally massive heat sink" cooling member **26**. In contrast, FIGS. 27A and 28 of Chiang illustrate that ESC **6** (with resistive heater **72**) and cooling plate **110** are both thermally massive structures. Likewise, FIG. 1 of Yatsuda illustrates a thermally massive worktable **18** and Yatsuda provides no disclosure of heating worktable **18** with a heating element.

Accordingly, because the combination of Yatsuda, Chiang and Ramanan does not suggest all claim features, Ramanan provides no recognition that the thickness of a heat transfer member is a result-effective variable, and no articulated reasoning has been provided for the combination of Yatsuda, Chiang and Ramanan, the rejection of Claims 1 and 15 under 35 U.S.C. § 103(a) is improper and should be reversed. Dependent Claims 2, 10, 12, 16, 21 and 23 are patentable over Yatsuda, Chiang and Ramanan at least for the same reasons as those discussed above regarding Claims 1 and 15.

C. Rejection Under 35 U.S.C. §103(a) Over Yatsuda, Chiang, Ramanan and Mahawili - Claims 8 and 19

Claims 8 and 19 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Yatsuda in view of Chiang and Ramanan and further in view of Mahawili (final Official Action at page 7, ¶1; at page 13, ¶5). However, the rejection

is improper because the combination of Yatsuda, Chiang, Ramanan and Mahawili does not disclose all claim features.

Claim 8 depends from Claim 1 and recites, *inter alia*, a substrate support wherein the ceramic member includes a recessed surface and a peripheral flange, the ceramic member has a thickness of from about 1-4 mm at the recessed surface; the heat transfer member is disposed on the recessed surface and laterally spaced from the flange; and the electrostatic chuck contacts the flange (emphasis added).

Claim 19 depends from Claim 15 and recites, *inter alia*, the heat transfer member is disposed on the recessed surface and laterally spaced from the flange, and the electrostatic chuck contacts the flange (emphasis added).

1. The Examiner's Position

The final Official Action acknowledges that Yatsudsa does not disclose the claim feature of "the heat transfer member ... laterally spaced from the flange" (final Official Action at page 10, ¶4; at page 14, ¶2), but contends that this missing feature is suggested by Yatsuda "to allow for thermal expansion of the heat transfer member between the heat transfer between ... [worktable] 18 and the ceramic member 20 at the high processing temperatures during wafer processing" (emphasis added) (final Official Action at page 10, ¶5; at page 14, lines 5-9). To support this position, the final Official Action provides a citation to Mahawili (final Official Action at pages 10-11, bridging paragraph; at page 14, lines 10-15).

2. Yatsuda Discloses Low Temperature Plasma Processing

Contrary to the Examiner's assertion that the claim features of Claims 8 and 19 are obvious "to allow for thermal expansion of the heat transfer member between the heat transfer between ... [worktable] 18 and ... ceramic member 20 at the high

processing temperatures during wafer processing" (emphasis added), Yatsuda discloses low temperature plasma processing (column 6, lines 19-21; lines 42-43). Yatsuda discloses that a "cooling jacket **34** ... is formed in the worktable **18**, so that the wafer W is kept at a predetermined temperature" (column 3, lines 53-55). Yatsuda discloses that the temperature of worktable **18** is set from -30°C to 30°C during processing (column 6, lines 19-21; lines 42-43). Thus, Yatsuda provides a suggestion that the effects of thermal expansion are minimal, because plasma processing is performed at a low temperature.

3. Mahawili Discloses an Actively Heated Substrate Platform

Moreover, Mahawili discloses that platform **10** includes heater assembly **24** for the active heating of substrate **12** on platform **10** (column 4, lines 39-44). Heater housing **22** and platform **10** directly overlies heater assembly **24** (FIG. 1) and are sized to accommodate thermal expansion from heating (column 5, lines 13-17).

However, Yatsuda provides no disclosure of an external heating source below worktable **18** and further discloses that worktable **18** is cooled by cooling jacket passages **34** (column 3, lines 53-55). Given these differences in construction, the final Official Action has provided no articulated reasoning for modifying worktable **18** and of Yatsuda with Mahawili's disclosure to include the claim feature of "the heat transfer member ... laterally spaced from the flange."

4. No Citation for the Claim Feature of the Ceramic Member Having a Thickness of From About 1-4 mm at the Recess Surface - Claim 8

The final Official Action has not identified any structure in Yatsuda, Chiang, Ramanan and Mahawili that corresponds to the claim feature of "the ceramic member has a thickness of from about 1-4 mm at the recessed surface." Thus, contrary to Federal Circuit precedent, the final Official Action "assert[s] an explicit or

implicit teaching or suggestion in the prior art" regarding subject matter of Claim 8, but without "indicat[ing] where such a teaching or suggestion appears in the reference." *In re Rijckaert*, 9 F.3d 1531, 1533, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993) (emphasis added).

As such, because the combination of Yatsuda, Chiang, Ramanan and Mahawili does not suggest all claim features, the rejection of Claims 8 and 19 is improper and should be reversed.

D. Rejection Under 35 U.S.C. §103(a) Over Yatsuda, Chiang, Ramanan and Gaylord - Claims 32 and 33

Claims 32 and 33 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Yatsuda in view of Chiang and Ramanan and further in view Gaylord et al. (U.S. Patent No. 5,849,076) ("Gaylord").

Claims 32 and 33 recite, *inter alia*, wherein the controller is operable to circulate a liquid having a first temperature through the at least one flow passage to control the temperature of the heat transfer member to a first temperature during processing of the substrate; circulating a liquid having a second temperature through the at least one flow passage to control the temperature of the heat transfer member to a second temperature during processing of the substrate; wherein the temperature of the heat transfer member is (i) ramped from the first temperature to the second temperature, or (ii) changed step-wise from the first temperature to the second temperature (emphasis added).

1. The Examiner's Position

The final Official Action acknowledges that the combination of Yatsuda, Chiang and Ramanan does not disclose all the features of Claims 32 and 33. The

final Official Action cites Gaylord for the disclosure of cooling system **74** for cooling gas ring **18** and seal plate **37** of barrel reactor **11** (final Official Action at page 15, ¶2-¶3) and concludes that claim feature of a "controller ... operable to circulate a liquid having a first temperature through the at least one flow passage to control the temperature of the heat transfer member to a first temperature during processing of the substrate; circulating a liquid having a second temperature through the at least one flow passage to control the temperature of the heat transfer member to a second temperature during processing of the substrate" is obvious (final Official Action at pages 15-16, bridging paragraph).

2. **No Citation for the Claim Feature of Heat Transfer Member is Ramped from the First Temperature to the Second Temperature or Changed Step-Wise from the First Temperature to the Second Temperature**

The final Official Action has not identified any disclosure in Yatsuda, Chiang, Ramanan or Gaylord that corresponds to the claim feature of "wherein the temperature of the heat transfer member is (i) ramped from the first temperature to the second temperature, or (ii) changed step-wise from the first temperature to the second temperature" Thus, contrary to Federal Circuit precedent, the final Official Action "assert[s] an explicit or implicit teaching or suggestion in the prior art" regarding subject matter of Claims 32 and 33, but without "indicat[ing] where such a teaching or suggestion appears in the reference." *In re Rijckaert*, 9 F.3d 1531, 1533, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993) (emphasis added).

3. **Missing Claim Feature of Circulating a Liquid Having a First Temperature and Circulating a Liquid Having a Second Temperature During Processing of the Substrate**

Gaylord discloses a chemical vapor deposition barrel reactor (column 4, lines 21-23) with reaction chamber vessel **12** and radiant heat lamps **26** (column 4, lines 35-40). Gaylord further discloses that heat lamps **26** provide a source of energy to heat reactor components, including gas ring **18** and seal plate **37** (column 7, lines 7-10). Cooling system **74** of Gaylord cools gas ring **18** and seal plate **37** (column 5, lines 49-52) to a first temperature when heat lamps **26** are active (column 7, lines 1-4) and when the barrel reactor **11** is in operation (column 7, lines 4-8). When heat lamps **26** are de-energized, the cooling system **74** switches to a second temperature (column 7, lines 19-22). However, Gaylord provides no disclosure that cooling system **74** switches from a first temperature to a second temperature <u>during operation</u> of barrel reactor **11**. Thus, Gaylord provides no disclosure of a "controller ... operable to circulate a liquid having a first temperature through the at least one flow passage to control the temperature of the heat transfer member to a first temperature during processing of the substrate; circulating a liquid having a second temperature through the at least one flow passage to control the temperature of the heat transfer member to a second temperature during processing of the substrate," as recited in Claims 32 and 33.

As such, because the combination of Yatsuda, Chiang, Ramanan and Gaylord does not suggest all claim features, the rejection of Claims 32 and 33 is improper and should be reversed.

VIII. <u>Claims Appendix</u>

See attached Claims Appendix for a copy of the claims involved in this appeal.

IX. Evidence Appendix

Appellant does not rely on any evidence for this appeal.

X. Related Proceedings Appendix

There are no Related Proceedings for this appeal as indicated on the attached Related Proceedings Appendix.

XI. Conclusion

For the reasons set forth above, it is respectfully submitted that the pending claims are allowable. Reversal of the rejections is respectfully requested.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

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VIII. CLAIMS APPENDIX

The Appealed Claims

1. (Previously Presented) A substrate support useful in a reaction chamber of a plasma processing apparatus, the substrate support comprising:

a ceramic member;

a metallic heat transfer member overlying the ceramic member, the heat transfer member having a maximum thickness of about ¼ inch, the heat transfer member including at least one flow passage through which a liquid can be circulated to heat and cool the heat transfer member;

an electrostatic chuck overlying the heat transfer member, the electrostatic chuck having a support surface for supporting a substrate in a reaction chamber of a plasma processing apparatus;

a source of temperature controlled liquid in flow communication with the at least one flow passage; and

a controller operable to control the volumetric flow rate and/or the temperature of the liquid circulated through the at least one flow passage, so as to control heating and cooling of the heat transfer member at a rate of from about 0.25-2°C/sec, wherein heating is performed solely by the heat transfer member.

2. (Original) The substrate support of Claim 1, wherein the heat transfer member has a maximum thickness of about 1/8 inch.

3. (Original) The substrate support of Claim 1, wherein the at least one flow passage has a width of about 1/32 to about 3/32 inch, and a depth of about 1/32 to about 1/16 inch.

4. (Cancelled)

5. (Previously Presented) The substrate support of Claim 1, wherein the source of temperature controlled liquid includes a Peltier cooler operable to change the temperature of the liquid to a selected temperature.

6. (Previously Presented) The substrate support of Claim 1, further comprising:

a heat transfer gas source operable to supply a heat transfer gas between the support surface and the substrate;

wherein the controller is operable to control the flow rate and/or pressure of the heat transfer gas supplied between the support surface and the substrate.

7. (Original) The substrate support of Claim 1, wherein the heat transfer member comprises a base including the at least one flow passage, and a cover overlying the base.

8. (Original) The substrate support of Claim 1, wherein: the ceramic member includes a recessed surface and a peripheral flange, the ceramic member has a thickness of from about 1-4 mm at the recessed surface; the heat transfer

member is disposed on the recessed surface and laterally spaced from the flange; and the electrostatic chuck contacts the flange.

9. (Original) The substrate support of Claim 1, further comprising a ceramic ring overlying the ceramic member and surrounding the heat transfer member and the electrostatic chuck, the heat transfer member being laterally spaced from the ceramic ring, the electrostatic chuck contacting the ceramic ring.

10. (Original) The substrate support of Claim 1, further comprising an RF power source electrically connected to the heat transfer member.

11. (Original) The substrate support of Claim 1, further comprising an elastomeric joint between the ceramic member and the heat transfer member, and an elastomeric joint between the heat transfer member and the electrostatic chuck.

12. (Original) A plasma processing apparatus comprising the substrate support of Claim 1.

13. (Withdrawn) A method of thermally controlling a substrate in a plasma processing apparatus, comprising: placing a substrate on the support surface of the substrate support according to Claim 1 in a reaction chamber of a plasma processing apparatus; introducing a process gas into the reaction chamber; generating a plasma from the process gas in the reaction chamber; processing the substrate; and circulating a liquid through the at least one flow passage to control the temperature

of the heat transfer member to a selected temperature during processing of the substrate.

14. (Withdrawn) The method of Claim 13, further comprising: circulating a liquid having a first temperature through the at least one flow passage to control the temperature of the heat transfer member to a first temperature during processing of the substrate; and circulating a liquid having a second temperature through the at least one flow passage to control the temperature of the heat transfer member to a second temperature during processing of the substrate; wherein the temperature of the heat transfer member is (i) ramped from the first temperature to the second temperature, or (ii) changed step-wise from the first temperature to the second temperature.

15. (Previously Presented) A substrate support useful in a plasma processing apparatus, comprising: a source of temperature controlled liquid; a ceramic member; a metallic heat transfer member overlying the ceramic member, the heat transfer member including at least one flow passage in fluid communication with the liquid source and through which the liquid can be circulated to heat and cool the heat transfer member at a rate of from about 0.25-2 °C/sec; an electrostatic chuck overlying the heat transfer member, the electrostatic chuck having a support surface for supporting a substrate in a reaction chamber of a plasma processing apparatus; and a controller operable to control the volumetric flow rate and/or the temperature of the liquid circulated through the at least one flow passage, wherein heating is performed solely by the heat transfer member.

16. (Original) The substrate support of Claim 15, wherein the heat transfer member has a maximum thickness of 1/8 inch.

17. (Previously Presented) The substrate support of Claim 15, further comprising: a heat transfer gas source operable to supply a heat transfer gas between the support surface and the substrate; wherein the controller is operable to control the flow rate and/or pressure of the heat transfer gas source.

18. (Original) The substrate support of Claim 15, wherein the heat transfer member comprises a base including at least one flow passage, and a cover overlying the base.

19. (Original) The substrate support of Claim 15, wherein the ceramic member includes a recessed surface and a peripheral flange, the heat transfer member is disposed on the recessed surface and laterally spaced from the flange, and the electrostatic chuck contacts the flange.

20. (Original) The substrate support of Claim 15, further comprising a ceramic ring overlying the ceramic member and surrounding the heat transfer member and the electrostatic chuck, the heat transfer member being laterally spaced from the ceramic ring, the electrostatic chuck contacting the ceramic ring.

21. (Original) The substrate support of Claim 15, further comprising an RF power source electrically connected to the heat transfer member.

22. (Original) The substrate support of Claim 15, further comprising an elastomeric joint between the ceramic member and the heat transfer member, and an elastomeric joint between the heat transfer member and the electrostatic chuck.

23. (Original) A plasma processing apparatus comprising the substrate support of Claim 15.

24. (Withdrawn) A method of thermally controlling a substrate in a plasma processing apparatus, comprising: placing a substrate on the support surface of the substrate support according to Claim 15 in a reaction chamber of a plasma processing apparatus; introducing a process gas into the reaction chamber; generating a plasma from the process gas in the reaction chamber; processing the substrate; and circulating the liquid from the liquid source through the at least one flow passage to control the temperature of the heat transfer member to a selected temperature during processing of the substrate.

25. (Withdrawn) The method of Claim 24, further comprising: circulating a liquid having a first temperature through the at least one flow passage to control the temperature of the heat transfer member to a first temperature during processing of the substrate; and circulating a liquid having a second temperature through the at least one flow passage to control the temperature of the heat transfer member to a

second temperature during processing of the substrate; wherein the temperature of the heat transfer member is (i) ramped from the first temperature to the second temperature, or (ii) changed step-wise from the first temperature to the second temperature.

26. (Withdrawn) A method of processing a substrate in a plasma processing apparatus, comprising: supporting a substrate on a support surface of an electrostatic chuck in a reaction chamber of a plasma processing apparatus; plasma processing the substrate; circulating a liquid through at least one flow passage extending through a metallic heat transfer member underlying the electrostatic chuck so as to control the temperature of the substrate, the heat transfer member having a maximum thickness of about ¼ inch ; and controlling the volumetric flow rate and/or the temperature of the liquid circulated through the at least one flow passage, so as to control heating and cooling of the heat transfer member at a rate of from about 0.25-2°C/sec.

27. (Withdrawn) The method of Claim 26, wherein the heat transfer member has a maximum thickness of about 1/8 inch, and the at least one flow passage has a width of about 1/32 to 3/32 inch, and a depth of about 1/32 to 1/16 inch.

28. (Withdrawn) The method of Claim 26, further comprising supplying a heat transfer gas between the support surface and the substrate during plasma processing of the substrate.

29. (Withdrawn) The method of Claim 26, further comprising applying RF power to the heat transfer member.

30. (Cancelled)

31. (Withdrawn) The method of Claim 26, further comprising: circulating a liquid having a first temperature through the at least one flow passage to control the temperature of the heat transfer member to a first temperature during processing of the substrate; and circulating a liquid having a second temperature through the at least one flow passage to control the temperature of the heat transfer member to a second temperature during processing of the substrate; wherein the temperature of the heat transfer member is (i) ramped from the first temperature to the second temperature, or (ii) changed step-wise from the first temperature to the second temperature.

32. (Previously Presented) The substrate support of Claim 1, wherein the controller is operable to circulate a liquid having a first temperature through the at least one flow passage to control the temperature of the heat transfer member to a first temperature during processing of the substrate; circulating a liquid having a second temperature through the at least one flow passage to control the temperature of the heat transfer member to a second temperature during processing of the substrate; wherein the temperature of the heat transfer member is (i) ramped from

the first temperature to the second temperature, or (ii) changed step-wise from the first temperature to the second temperature.

33. (Currently Amended) The substrate support of Claim 15, wherein the controller is operable to circulate a liquid having a first temperature through the at least one flow passage to control the temperature of the heat transfer member to a first temperature during processing of the substrate; circulating a liquid having a second temperature through the at least one flow passage to control the temperature of the heat transfer member to a second temperature during processing of the substrate; wherein the temperature of the heat transfer member is (i) ramped from the first temperature to the second temperature, or (ii) changed step-wise from the first temperature to the second temperature.

31. (Withdrawn) The method of claim 26, further comprising: circulating a liquid having a first temperature through the at least one flow passage to control the temperature of the heat transfer member to a first temperature during processing of the substrate; and circulating a liquid having a second temperature through the at least one flow passage to control the temperature of the heat transfer member to a second temperature during processing of the substrate; wherein the temperature of the heat transfer member is (i) ramped from the first temperature to the second temperature, or (ii) changed step-wise from the first temperature to the second temperature.

IX. EVIDENCE APPENDIX

Appellant does not rely on any evidence for this appeal.

X. RELATED PROCEEDINGS APPENDIX

There are no related proceedings for this appeal.